

REMARKS

Allowed Subject Matter

Applicant thanks the Examiner for allowing Claims 1-45.

The Examiner has also provided the primary reasons he finds the above-referenced claims allowable. In response, Applicant notes that the patentability of each claim is based on the combination of elements in the claim as a whole and not just the specific element(s) cited by the Examiner. Accordingly, the Reasons for Allowance merely highlights individual elements considered persuasive by the Examiner and do not limit Applicant's invention, as recited in Claims 1-45, in any way.

Amendment to the Claims

In reviewing the claims, Applicant has noticed that Claim 38, as filed, includes a typographical error. In particular, a term $(p_i - p_i')$ is incorrectly (and nonsensically) defined as being the distance between positions p_i and p_i . The claim should correctly define the term as – between positions p_i and p_i' – . Applicant respectfully requests that because of the typographical nature of the error, and because the amendment does not add new matter to the application or require further search on the part of the Examiner, nor make more than a cursory review of the record necessary, nor involve materially added work on the part of the Patent Office, that Claim 38 be amended as indicated on Page 9 of this paper.

Examiner's Amendment and Entry of the Preliminary Amendment

Applicant further notes that in the Examiner's Amendment of May 9, 2005, the Examiner entered the Applicant's Preliminary Amendment received August 6, 2002, stating that Claims 17 and 19-23 were changed to replace "reference wafer" with – reference substrate – throughout the identified claims.

Applicant would like first to draw the Examiner's attention to the fact that the August 6, 2002 Preliminary Amendment is more correctly characterized as changing

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the identified claims to replace "wafer" with – substrate – since not all of the identified claims included the term *reference wafer* in their original form.

Secondly, please note that the August 6, 2002 Preliminary Amendment amended Claim 10 in the same manner as the above-identified claims, replacing "wafer" with – substrate –.

Thirdly, please note that the August 6, 2002 Preliminary Amendment also amended Claim 37, which was an obviously truncated claim as originally listed, to replace the words "from the" with the words – between two parallel sensors of the sensor system. –, thereby properly completing the claim.

Finally, the Preliminary Amendment of August 6, 2002 amends the paragraph beginning on page 16, line 3 of the specification to replace two instance of the word "blocked" with – remains unblocked –.

A copy of the Preliminary Amendment received by the Office on August 6, 2002 is included with this Amendment as Exhibit A. As was stated in the Preliminary Amendment, the Applicant asserts that these amendments add no new matter to the application. Furthermore, they do not require additional search on the part of the Examiner, they do not make more than a cursory review of the record necessary, nor do they involve materially added work on the part of the Patent Office. Applicant respectfully requests that the amendments to Claims 10, 17, 19-23, and 37, as well as to the paragraph beginning on page 16, line 3 of the specification be entered at this time, to the extent they have not already been entered.

Correction of Published Claim Language

Applicant further takes this opportunity to draw attention to several typographical errors in the claims that were introduced, through no fault on the part of the Applicant, during publication of the application.

In particular:

Claim 18, as published, incorrectly includes a reference to "lateral spacing" instead of to – lateral spacing *f* – as originally filed.

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In Claim 19, as published, the text following the equation twice refers incorrectly to “ l_{\min} ” and “ l_{\max} ” instead of to $-l_{\min}$ and $-l_{\max}$, representing minimum and maximum sensor lengths.

In Claim 21, the third element should correctly read – calculating an x_g displacement resulting from rotating through the angle θ_g using the formula for x in Claim 20; and – .

In Claim 22, the second equation should correctly read:

$$\Delta R = g + \delta - \sqrt{x^2 + (g + \delta + y)^2}$$

Applicant wishes to ensure that these typographical errors in the publication not be repeated in the printing of the issued patent.

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CONCLUSION

Applicant believes that no additional fees are required for the amendments and corrections requested herein. However, if any fees are due, please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: June 23, 2005

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AMEND

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Appl. No.	:	09/870,393)	I hereby certify that this correspondence and all
)	marked attachments are being deposited with
Filed	:	May 29, 2001)	the United States Postal Service as first-class
)	mail in an envelope addressed to: United States
For	:	METHOD AND APPARATUS)	Patent and Trademark Office, P.O. Box 2327,
		TO CORRECT WAFER DRIFT)	Arlington, VA 22202, on
)	
Examiner	:	Unknown)	<u>August 2, 2002</u>
)	(Date)
)	<u>Adeel S. Akhtar, Reg. No. 41,394</u>

PRELIMINARY AMENDMENT

United States Patent and Trademark Office
P.O. Box 2327
Arlington, VA 22202

Dear Sir:

Prior to examination on the merits, please amend the above-captioned application as follows:

IN THE SPECIFICATION:

Please amend the paragraph beginning on p. 16, line 3, as indicated in the replacement paragraph below:

The deviation in voltage readings are used to calculate 630 offsets Δ_L and Δ_R . Δ_L and Δ_R represent the linear deviations from the nominal wafer position, as measured longitudinally along the sensors (see Figure 12). Δ_L and Δ_R may be obtained from the following equation:

$$\Delta = \frac{l_{\max} - l_{\min}}{V_{\max} - V_{\min}} (V_{\text{ref}} - V)$$

Here, l_{\max} and l_{\min} represent maximum and minimum sensor laser beam lengths left unblocked by the wafer, V_{\max} and V_{\min} represent the output value of the sensors when l_{\max} and l_{\min} are left unblocked, V_{ref} indicates the sensor output value when the reference wafer is at the nominal

wafer position while the robot is at its nominal centering position, and V indicates the sensor output value when the process wafer is at the nominal wafer position and the sensor is thus partially blocked. For the illustrated embodiment, $l_{\max} = 10$ mm, $l_{\min} = 0$ mm, $V_{\max} = 5$ V, and $V_{\min} = 0$, so that

$$\Delta = 2(V_{\text{ref}} - V)$$

IN THE CLAIMS:

Please amend the Claims 10, 17, 19-23 and 37 as indicated in the clean versions below:

10. (Amended) The method of Claim 9, wherein each of the at least two proportionate sensors are partially blocked by a leading edge of the reference substrate at a second nominal robot position when the reference substrate data is recorded, and further comprising recording additional reference substrate data when each of the at least two proportionate sensors are partially blocked by a trailing edge of the reference substrate.

17. (Amended) The method of Claim 16, wherein calculating drift parameters (x, y) of the process substrate from the nominal substrate position comprises

calculating linear deviation Δ of an interception point of the process substrate edge relative to the reference substrate interception point for each of the at least two proportionate sensors;

calculating a lateral spacing f of each sensor from an axis of robot translation; and

calculating the drift parameters (x, y) from the linear deviations Δ , f and the substrate diameter d .

19. (Amended) The method of Claim 17, wherein, for each sensor,

$$\Delta = \frac{l_{\max} - l_{\min}}{V_{\max} - V_{\min}} (V_{\text{ref}} - V)$$

where l_{\max} and l_{\min} represent maximum and minimum sensor lengths blocked by the substrate, V_{\max} and V_{\min} represent the output value of the sensors when l_{\max} and l_{\min} are blocked, V_{ref} indicates the sensor output value when the substrate is at the nominal position, and V indicates the sensor output value when the process substrate is at the nominal substrate position.

20. (Amended) The method of Claim 19, wherein (x, y) are calculated using the following formulae:

$$x = \frac{1}{2} \left[f_L - f_R + \sqrt{\left(\frac{d}{s}\right)^2 - 1} \left(\Delta_L - \Delta_R + \sqrt{\left(\frac{d}{2}\right)^2 - f_L^2} - \sqrt{\left(\frac{d}{2}\right)^2 - f_R^2} \right) \right]$$

$$y = \frac{1}{2} \left[-\sqrt{\left(\frac{d}{s}\right)^2 - 1} (f_L + f_R) + \left(\Delta_L + \Delta_R + \sqrt{\left(\frac{d}{2}\right)^2 - f_L^2} + \sqrt{\left(\frac{d}{2}\right)^2 - f_R^2} \right) \right]$$

$$s^2 = (f_L + f_R)^2 + \left(\Delta_L - \Delta_R + \sqrt{\left(\frac{d}{2}\right)^2 - f_L^2} - \sqrt{\left(\frac{d}{2}\right)^2 - f_R^2} \right)^2$$

wherein d represents the substrate diameter, Δ_L and Δ_R are the substrate deviations of the two sensors, and f_L and f_R are the lateral spacing from left and right sensors, respectively, to an axis of robot translation.

21. (Amended) The method of Claim 20, further comprising determining the nominal robot position by:

- moving the robot with the reference substrate to the nominal robot position;
- rotating the reference substrate through an angle θ_g ;
- calculating an x_g displacement resulting from rotating through the angle θ_g using the formula for x in Claim 20; and
- obtaining a value g by substituting the value of x_g obtained into the following formula:

$$g = \frac{x_g}{\sin \theta_g}$$

22. (Amended) The method of Claim 21, wherein compensating for substrate drift comprises changing the position of the robot supporting the process substrate in accordance with the following formulae:

$$\Delta\theta = \sin^{-1}\left(\frac{-x}{\sqrt{x^2 + (g + \delta + y)^2}}\right)$$

$$\Delta R = g + \delta - \sqrt{x^2 + (g + \delta + y)^2}$$

where ΔR indicates a compensating change along the translation axis, $\Delta\theta$ indicates a compensating change in rotational position, g is calculated from the formula of Claim 21, (x, y) are calculated from the formulae of Claim 20 and δ represents a change in robot position from the positioning station g when compensation is made.

23. (Amended) The method of Claim 1, further comprising determining the nominal robot position for use in compensating for the substrate drift by intentionally inducing a drift, measuring the induced drift and calculating reference substrate position based upon the measured induced drift.

37. (Amended) The method of Claim 36, wherein f_i is proportional to a lateral distance between two parallel sensors of the sensor system.

REMARKS

Prior to examination on the merits, Applicant has amended the application to correct obvious grammatical errors and to harmonize the claim language and specification teachings. Applicant respectfully submits that no new matter is added. The amendments to the specification are consistent with the teachings of the application as a whole. The amendments to the claims merely attempt to match follow-on recitations with their antecedents. Claim 37 is amended to complete an incomplete claim as filed, but is fully supported by the application as filed.

In view of the foregoing amendments, Applicant respectfully submits the application is in condition for examination on the merits and respectfully requests the same.

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Attached hereto is a separate paper entitled VERSION OF THE AMENDMENTS
SHOWING CHANGES MADE, in which additions are shown in double underlining and
deletions are shown ~~stricken through~~.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: August 2, 2002

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VERSION SHOWING CHANGES MADE TO THE CLAIMS

IN THE SPECIFICATION:

The paragraph beginning on page 16, line 3 has been amended as follows:

The deviation in voltage readings are used to calculate 630 offsets Δ_L and Δ_R . Δ_L and Δ_R represent the linear deviations from the nominal wafer position, as measured longitudinally along the sensors (see Figure 12). Δ_L and Δ_R may be obtained from the following equation:

$$\Delta = \frac{l_{\max} - l_{\min}}{V_{\max} - V_{\min}} (V_{\text{ref}} - V)$$

Here, l_{\max} and l_{\min} represent maximum and minimum sensor laser beam lengths ~~blocked left~~ unblocked by the wafer, V_{\max} and V_{\min} represent the output value of the sensors when l_{\max} and l_{\min} are ~~blocked left~~ unblocked, V_{ref} indicates the sensor output value when the reference wafer is at the nominal wafer position while the robot is at its nominal centering position, and V indicates the sensor output value when the process wafer is at the nominal wafer position and the sensor is thus partially blocked. For the illustrated embodiment, $l_{\max} = 10$ mm, $l_{\min} = 0$ mm, $V_{\max} = 5$ V, and $V_{\min} = 0$, so that

$$\Delta = 2(V_{\text{ref}} - V)$$

IN THE CLAIMS:

10. (Amended) The method of Claim 9, wherein each of the at least two proportionate sensors are partially blocked by a leading edge of the reference ~~wafer~~ substrate at a second nominal robot position when the reference substrate data is recorded, and further comprising recording additional reference substrate data when each of the at least two proportionate sensors are partially blocked by a trailing edge of the reference ~~wafer~~ substrate.

17. (Amended) The method of Claim 16, wherein calculating drift parameters (x, y) of the process substrate from the nominal ~~wafer~~ substrate position comprises

calculating linear deviation Δ of an interception point of the process substrate edge relative to the reference ~~wafer~~ substrate interception point for each of the at least two proportionate sensors;

calculating a lateral spacing f of each sensor from an axis of robot translation; and

calculating the drift parameters (x, y) from the linear deviations Δ , f and the substrate diameter d .

19. (Amended) The method of Claim 17, wherein, for each sensor,

$$\Delta = \frac{l_{\max} - l_{\min}}{V_{\max} - V_{\min}} (V_{\text{ref}} - V)$$

where l_{\max} and l_{\min} represent maximum and minimum sensor lengths blocked by the ~~wafer~~ substrate, V_{\max} and V_{\min} represent the output value of the sensors when l_{\max} and l_{\min} are blocked, V_{ref} indicates the sensor output value when the ~~wafer~~ substrate is at the nominal position, and V indicates the sensor output value when the process substrate is at the nominal ~~wafer~~ substrate position.

20. (Amended) The method of Claim 19, wherein (x, y) are calculated using the following formulae:

$$x = \frac{1}{2} \left[f_L - f_R + \sqrt{\left(\frac{d}{s}\right)^2 - 1} \left(\Delta_L - \Delta_R + \sqrt{\left(\frac{d}{2}\right)^2 - f_L^2} - \sqrt{\left(\frac{d}{2}\right)^2 - f_R^2} \right) \right]$$

$$y = \frac{1}{2} \left[-\sqrt{\left(\frac{d}{s}\right)^2 - 1} (f_L + f_R) + \left(\Delta_L + \Delta_R + \sqrt{\left(\frac{d}{2}\right)^2 - f_L^2} + \sqrt{\left(\frac{d}{2}\right)^2 - f_R^2} \right) \right]$$

$$s^2 = (f_L + f_R)^2 + \left(\Delta_L - \Delta_R + \sqrt{\left(\frac{d}{2}\right)^2 - f_L^2} - \sqrt{\left(\frac{d}{2}\right)^2 - f_R^2} \right)^2$$

wherein d represents the ~~wafer~~ substrate diameter, Δ_L and Δ_R are the ~~wafer~~ substrate deviations of the two sensors, and f_L and f_R are the lateral spacing from left and right sensors, respectively, to an axis of robot translation.

21. (Amended) The method of Claim 20, further comprising determining the nominal robot position by:

moving the robot with the reference substrate to the nominal robot position;

rotating the reference ~~wafer~~ substrate through an angle θ_g ;

calculating an x_g displacement resulting from rotating through the angle θ_g using the formula for x in Claim 20; and

obtaining a value g by substituting the value of x_g obtained into the following formula:

$$g = \frac{x_g}{\sin \theta_g}$$

22. (Amended) The method of Claim 21, wherein compensating for substrate drift comprises changing the position of the robot supporting the process ~~wafer~~ substrate in accordance with the following formulae:

$$\Delta\theta = \sin^{-1} \left(\frac{-x}{\sqrt{x^2 + (g + \delta + y)^2}} \right)$$

$$\Delta R = g + \delta - \sqrt{x^2 + (g + \delta + y)^2}$$

where ΔR indicates a compensating change along the translation axis, $\Delta\theta$ indicates a compensating change in rotational position, g is calculated from the formula of Claim 21, (x, y) are calculated from the formulae of Claim 20 and δ represents a change in robot position from the positioning station g when compensation is made.

23. (Amended) The method of Claim 1, further comprising determining the nominal robot position for use in compensating for the substrate drift by intentionally inducing a drift,

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measuring the induced drift and calculating reference ~~wafer~~ substrate position based upon the measured induced drift.

37. (Amended) The method of Claim 36, wherein f_i is proportional to a lateral distance ~~from the~~ between two parallel sensors of the sensor system.

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